IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Holcomb, et al.

Application No.: 09/815,376

Filed: March 21, 2001

For: COMBINATION DIFFERENTIAL AND ABSOLUTE PRESSURE TRANSDUCER FOR LOAD LOCK CONTROL

Attorney Docket No.: 16458-050

Group No.: 3634

Examiner: Gregory J. Strimbu

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Commissioner of Patents
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DECLARATION OF MATTHEW TAYLOR

I, Matthew Taylor, declare and state as follows:

1. I am a Sales and Applications Engineer employed by MKS Instruments, Inc. ("MKS"), the assignee of this patent application.

2. At all times relevant to this Declaration, including the period of August 1998 through May 1999 and continuing to November 2002, I was the Key Account Manager assigned by MKS to the Applied Materials, Inc., customer account. In that position, most of my time was spent at the Applied Materials, Inc., research, development, and training facility in Santa Clara, California. In this position, I was the principal contact of MKS with Applied Materials for activities relating to the development of the invention that is the subject matter of this patent application. The inventors were, and some still are, employed by MKS at its HPS Division in Boulder, Colorado.

3. In approximately July of 1998, test engineers at Applied Materials complained about excessive particulate contamination getting through their load lock equipment and into the

reaction chambers, where such particulate contamination can be incorporated into thin film depositions and thereby damage or ruin them for use in semiconductor device fabrication. Such problems were being caused or exacerbated by inability to control opening and closing of the load lock doors without adverse results of pressure bursting. Test engineers at Applied Materials asked me if MKS could help them solve these problems.

4. One of the inventors of this patent application, Jim Stafford, who was an engineer in the HPS Division of MKS, but who is no longer with the company, apparently had already thought about this problem, and, on or about November 2, 1997, shortly after the publication of "Pressure measurement and control in loadlocks" by Hanson and Whitenack in Solid State Technology, October 1997, he came up with an idea of using existing MKS Baratron 41 Series atmospheric switch and a HPS pirani gauge together for controlling load locks (see Exhibit 1). Please note that Jim Stafford's internal "New Product Definition Proposal", Exhibit 1, indicates on its face that the idea came to him on November 2, 1997. However, that proposal itself is unsigned and the submission date is left blank. Therefore, I do not know when it was actually submitted---possibly around the time I brought Applied Materials' request back to MKS engineers.

5. MKS undertook this challenge to work with Applied Materials R&D engineers in an attempt to solve Applied Materials' load lock control problems based on Jim Stafford's idea in what is known at MKS as a "special" project. Undertaking to help customers solve problems in this manner is a fairly common practice at MKS. Such special projects are generally pursued in cooperation with the customer under a blanket confidentiality agreement with the understanding that both MKS and Applied Materials will keep each other's information confidential during the research and development effort. The basis for the understanding is that Applied Materials

would not disclose MKS's R&D and potential new product efforts to MKS's competitors, and MKS would not disclose or try to sell successful solutions to other MKS customers, especially those that might be competitors of Applied Materials, for at least two years after a successful solution is developed. Often, as in this case, the customer helps to defray at least part of the R&D cost by, for example, agreeing to pay some amount for each prototype made by MKS, and helps with the development effort by providing details of the problem, performance criteria needed to solve the problem, facilities and personnel for testing performance, providing feedback to MKS regarding test results and the like. There is, of course, the hope by the customer that MKS can solve its problem and the hope by MKS that finding a solution will enhance the customer relationship and possibly lead to development of a new product that may be commercializeable for ordinary marketing and sales to that particular customer as well as eventually to other customers or potential customers.

6. MKS's initial approach, as shown in the "Quotation", dated July 24, 1998 (Exhibit 2) was simply to provide an existing MKS 41A11DCA2BA003 Atmosphere Detection Switch set to trip at 3 Torr below atmosphere with relays that actuate below setpoint and an existing VCR 4 fitting along with a 1003250021 HPS 325 Moducell pirani with a DC input/output 8 VCR-F fitting.

7. The concept quickly evolved, as shown by the substitute "Quotation", dated August 20, 1998 (Exhibit 3), to a combination Gauge pirani/Switch, comprising a pirani gauge with internal 41 Series atmosphere detection switch. As shown by the September 2, 1998, drawings no. 93-7585 and 93-7585A in Exhibit 4, the implementation was to modify a MKS Series 325 Moducell pirani sensor and mount it along with a MKS Series 41 Baratron pressure

switch on a tubular manifold and to connect the electric cables of both of these devices together in a common connector. The contract price of $550.00 was just about enough to cover the parts.

8. Exhibit 5 is a copy of Jim Stafford's notes of a meeting on October 15, 1998, attended by Jim Stafford, Stacy Wade, and John Skuba, design engineers in the HPS Division of MKS, Boulder, Colorado, and Luke Hinkle, Bob Maxwell, Jim Poulin, and Jack Gillespie of MKS, Andover, Massachusetts, regarding this special project, including costs and drawings of the pirani sensor, how the switch could be calibrated, and mentioning an apparent underwhelming interest in the project.

9. Nevertheless, Jim Stafford and others at MKS put together two initial prototypes in Boulder and sent them on consignment (i.e., no cost) to me in Santa Clara, California. The MKS computer records (Exhibit 6) indicate that one of these two initial prototypes was sent to me on October 1, 1998, and the other on October 7, 1998. However, the actual Shipping Document (Exhibit 7) shows that both of these initial prototypes were actually shipped to me nearly a month later on October 30, 1998. I do not know why there is a discrepancy between these two records.

10. I took the two initial prototypes to Applied Materials to show them how the prototypes would be made for testing. Exhibit 8 is a copy of notes (probably authored by Jim Stafford, who was at the meeting) regarding a November 4, 1998, visit with Fred Hariz, of Applied Materials, regarding several criteria and desires of Applied Materials for the product. (While the notes in Exhibit 8 refer to "Frank", I am quite sure it was actually Fred Hariz.)

11. According to Exhibit 6, eight more prototypes were then shipped to Applied Materials on or about November 12, 1998 for testing. MKS does not have any load lock equipment, so MKS could not test the prototypes itself. They needed to be tested on an actual

load lock to see how they would behave. Applied Materials, however, had a research and training facility in Santa Clara, California, where it has load lock equipment set up for training, testing, and development purposes. Therefore, it was decided to test a number of MKS's initial prototypes on load locks at the Applied Materials research and training facility. None of the load locks in the Applied Materials' Santa Clara research and training facility, where the prototypes were tested, were set up to actually produce thin film depositions, and this Santa Clara facility is staffed by design engineers and research and development personnel, not production personnel. However, the load locks at the Applied Materials' Santa Clara facility could be, and were, used to run experiments with the prototypes supplied by MKS to run particle measurement and other performance tests in various atmospheric pressures and other conditions. A planned schedule for development, testing, and commercialization of the product is included in Exhibit 9.

12. Applied Materials' engineers were in charge of testing the prototypes, but I was present at the Applied Materials' research and training facility and/or received feedback for most, if not all, of the testing, which I believe started in about November 1998. I do know, as illustrated by the series of e-mails in Exhibit 10, that during the period of December 1998 through March 1999, the prototypes and test results were very frustrating. The prototypes were not able to operate the load locks as intended or as needed for them to be an improvement over the conventional pressure transducers for operating load locks. For example, they opened the load lock doors erratically and at the wrong times, and the particle control was not satisfactory. Applied Materials' engineers became disenchanted and were expressing skepticism about MKS's ability to solve the load lock control with this combination differential and absolute pressure transducer approach. The MKS engineers were trying to solve the problems, but, as shown by the e-mails in Exhibit 10, frustrations surfaced and tempers sometimes flared.

13. As shown by the partial chronology in Exhibit 11, there were significant hysteresis problems with the experimental prototype. Tiny changes in pressure would cause the switch to change states, a phenomenon known as "chattering." The original dead-band for the differential pressure switches was 0.3% of the full scale range of 10 Torr. Testing indicated that this hysteresis was too low. In December of 1998, Applied agreed to increase the dead-band to 10%. Although these modified differential pressure switches seemed to work initially, after extended testing in January and February of 1999, Applied Materials discovered that following certain sequences in a "maintenance mode" on their machine caused a pressure change in the load lock, preventing the load lock door from opening. Next, the atmospheric switches were replaced with 100 Torr differential pressure switches, and the dead-band was increased to 25%. These new sensors were sent by MKS in February 1999 to Applied Materials' Santa Clara testing facility. On February26 and 27, 1999, further testing indicated that the 100 Torr, 25% dead-band switches would not work. MKS subsequently determined that the electric circuit design was incapable of working with atmospheric switches having those settings. Therefore, on or about March 1, 1999, Applied Materials conceded that 100 Torr, 25% hysteresis was not going to work either and consented to trying the 10 Torr, 10% dead-band again for the differential pressure switch and to see if it could somehow be made more reliable over the long term, including in maintenance mode sequencing, than the previous 10 Torr, 10% dead-band switch and circuit. During the period of about March 9-12, 1999, MKS engineering again analyzed the circuit and, using "found" parts, cobbled together what they thought would be a modified 10 Torr, 10% dead-band differential pressure switch, which was then sent to me for verification of its performance at Applied Materials. Testing at Applied Materials verified the 10 Torr, 10% dead-band in that differential switch. While one switch is not a meaningful sample, it was an

indicator that the electronic design modifications may be correct for those scale range, setpoint, and hysteresis targets. MKS engineering needed to know that those modifications were successful prior to making any further changes and before incorporating such modified atmospheric switches along with pirani gauges into new combination differential and absolute pressure prototypes for further testing on load locks to ensure that the previous problems would not recur or new ones arise. That information about the successful verification of the new circuit for the 10 Torr, 10% dead-band was provided to MKS engineering on March 23, 1999.

14. Also, in the course of working with that atmospheric switch, the inventors learned of problems in assembly/calibration procedures, and they did not think they could not make the switch reliably until those issues were analyzed and resolved. Because of the uncertainty caused by the problems discovered in the last switch, it was decided that MKS engineering needed to obtain, modify, and study four new atmospheric switches to try to understand the calibration/test problems and to develop documentation based on the findings. Therefore, MKS engineering obtained four new standard differential pressure switches on March 24, 1999, which they then baselined, modified, and verified. Those four modified switches were then used by MKS engineering to make four new combination differential and absolute pressure transducer prototypes for testing in load locks. Actually, I am not certain, but I believe those four new prototypes were made by re-working four of the previous prototypes that were returned to MKS from Applied Materials. Such re-working would have included replacing the old atmospheric switches with the new, modified switches.

15. On March 29, 1999, two of the re-worked prototype units complete with the modified atmospheric pressure switches, i.e., with the 10 Torr full scale range, 2 Torr setpoint, and 10% hysteresis specifications, mounted along with pirani switches on manifold weldments

with Y-cables and connectors, were sent by MKS to Applied Materials, and on March31, 1999, two more of the re-worked prototypes were sent to Applied Materials (see Exhibit 12) for testing on load locks at the Applied Materials' research and training facility. The results of those tests on actual load locks were also more encouraging, with a lot of the initial chattering and reliability problems, including the maintenance mode failures, of the earlier prototypes apparently eliminated. By mid-April 1999, after longer test periods on the four re-worked prototypes, Applied Materials' engineers were showing an increase in confidence that MKS could produce the manifolded combination differential and absolute pressure transducer and that it could work reliably on load locks, but people involved were not sure, yet, that it would work well enough to replace previous state-of-the art pressure transducers.

16. Following the encouraging test results in the first two weeks in April 1999 from the four prototypes sent to Applied Materials on March29, 1999, and March31, 1999, as discussed above, three more prototypes were sent to Applied Materials on April 19, 1999 (see Exhibit 12) for testing. By May 1999, the people involved were generally satisfied that the invention was capable of functioning for its intended purpose, although many improvements still needed to be made, for example, in integrating the two pressure sensors together electronically, making mechanical and packaging improvements, etc.

17. Exhibit 13 includes the following drawings, which illustrate examples of the evolution from the prototype to product development after April 1999:

Drawing No.	**Date**
100010688	April 14, 1999
100010690	April 14, 1999
PROTO	July 28, 1999
41A-16296 MKS SW.	August 26, 1999
100010479	December 13, 1999

Drawing No.	Date
100010689	December 21, 1999
100010480	December 23, 1999
100010691	January 7, 2000
100010481	January 10, 2000

18. To the best of my knowledge, I do not believe that any of the prototypes sent to and tested in Applied Materials' research and training facility before April 1999 were used in load locks at other facilities, including Applied Materials' facilities, that actually produced thin film products (at least not before April 1999), thus were not used in commercial production. Also, MKS did not offer or sell products based on these prototypes to other MKS customers until at least several years later, when a much improved version was eventually released for sale.

19. Exhibit 14 shows shipments of additional prototypes sent to Applied Materials from May 1999 to August 1999, at least some, if not all, of which probably were used by Applied Materials on load locks for reaction chambers that were in commercial production of thin film products.

20. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001, and that such willful false statements may jeopardize the validity of any application or any patent issued thereon.

Matthew Taylor

Dated: 9/24/03